

Original Research Article

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Effect of Integrated Nutrient Management on Growth and Yield of Potato (*Solanum tuberosum* L.)

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ABSTRACT

A field experiment was conducted during the *Rabi* season of the year 2017-18 on potato with variety *Kufri Ashoka* to test the recommended dose of fertilizers (RDF) levels (0, 50, 75, 100, 125, 150%) with two organic manures (vermicompost 5 t/ha and mustard oil cake 2.5 t/ha) at research farm of Tirhut college of Agriculture Dholi, Muzaffarpur, Bihar. The experiment was carried out in randomized block design (RBD) with twelve treatments and replicated thrice. The soil of experimental plot was *Entisols*, sandy loam in texture under low available in N, P and K with pH 8.3. Among all growth and yield parameters like per cent plant emergence, plant height, number of shoots per plant, number of leaves per plant, dry matter accumulation, and tuber yield were recorded higher with the application of treatment T₁₁ - 150% RDF + 5.0 t/ha vermicompost which was significantly superior over T₁ - absolute control, T₂ - 100% RDF, T₃ - 50% RDF + 5.0 t/ha vermicompost, T₄ - 50% RDF + 2.5 t/ha mustard oil cake, T₅ - 75% RDF + 5.0 t/ha vermicompost and T₆ - 75% RDF + 2.5 t/ha mustard oil cake but was statistically at par with treatments, T₇ - 100% RDF + 5.0 t/ha vermicompost, T₈ - 100% RDF + 2.5 t/ha mustard oil cake, T₉ - 125% RDF + 5.0 t/ha vermicompost, T₁₀ - 125% RDF + 2.5 t/ha mustard oil cake and T₁₂ - 150% RDF + 2.5 t/ha mustard oil cake.

Keywords

Recommended dose of fertilizers, Vermicompost, Mustard oil cake and *Kufri Ashoka*

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Introduction

Potato (*Solanum tuberosum* L.) is a staple food crop of the world and it ranks next to rice, wheat and maize. It is highly amenable to adjustment and fits well in various cropping systems. Potato is well known for highest food value in the world. It has a high nutritive value, rich in contents like carbohydrates 20.6 %, protein 2.1 %, fat 0.3 % and crude fiber 1.1 %. It is the cheapest source of nutrition for the rural mass hence it is called as “poor man’s

friend”. The per capita consumption of potato in India is only 16 kg per annum but other countries the consumption of potato per capita is quite high thus the use of cereals should be substituted by potato in Indian scenario. It contains five alkaline elements like sodium, potassium, magnesium, calcium and aluminum, hence it acts as a systemic alkaliser to avoid gastric diseases. Boiled tubers when eaten as food without spice and oils, it may be better substitute of rice and bread (Bist and Sharma, 1997). Though, potato has low

content of fat, while in mineral content, potato produce mineral 1.1 g, phosphorus 75.2 g, calcium 18.8 g, iron 1.30 g, carbohydrate 42.50 g, fibre 752 g, fat 188 g, vitamin C 32 g, vitamin B 2.5 g/ha/day, which is much higher than the cereal crops (Yadav *et al.*, 2007). It also contains a good amount of amino acids such as leucine, tryptophan and isoleucine (Paul Khurana and Naik, 2003). It may be served as boiled, steamed, fried, baked, roasted or as ingredient of soups, stews and fries. Potato is main ingredients of vegetarian and non-vegetarian food.

India is the second largest potato producing country in the world after China. In India, during 2015-16, potato is grown over an area of 2.11 million hectare with an annual production of 43.41 million tonnes with an average yield of 20.5 t/ha. Almost 85% of total production comes from north India plain viz. Uttar Pradesh, West Bengal and Bihar. In world scenario, India has got second position after China with respect to production.

Bihar is the third largest potato producer state of the country, occupying 5% area of total cultivated land *i.e.* 0.31 million hectare with a production of 6.34 million tonnes and productivity 19.88 t/ha (Horticultural statistics at a glance 2017). The productivity of potato can be increased and sustained by adoption of integrated nutrient management. Keeping this point in view the present investigation has been carried out.

Materials and Methods

The field experiment was conducted during *Rabi* season in year 2017-18 at the farm of Tirhut College of Agriculture, Dholi (Muzaffarpur) which is situated on the southern bank of the river *Burhi Gandak* at an altitude of 52.18 meter above mean sea level and lies at 25°.98' N latitude and 85°.6' E longitude.

Field experimental was laid out in Randomized Block Design with twelve treatments *viz.*, T₁ - absolute control, T₂ - 100% RDF, T₃ - 50% RDF + 5.0 t/ha vermicompost, T₄ - 50% RDF + 2.5 t/ha mustard oil cake, T₅ - 75% RDF + 5.0 t/ha vermicompost, T₆ - 75% RDF + 2.5 t/ha mustard oil cake, T₇ - 100% RDF + 5.0 t/ha vermicompost, T₈ - 100% RDF + 2.5 t/ha mustard oil cake, T₉ - 125% RDF + 5.0 t/ha vermicompost, T₁₀ - 125% RDF + 2.5 t/ha mustard oil cake, T₁₁ - 150% RDF + 5.0 t/ha vermicompost and T₁₂ - 150% RDF + 2.5 t/ha mustard oil cake and replicated thrice.

Description of experimental variety

Kufri Ashoka

Kufri Ashoka developed through clonal selection from the segregating population of the hybrid EM/C-1021 x CP-1468. Central Potato Research Institute, Shimla, released this variety in 1996. Tubers are white, large, oval-long, smooth-skin, fleet eyes and white flesh, grown in north and south Indian hills, parts of Bihar, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Punjab, Uttar Pradesh and west Bengal. Yield potential is 20-30 t/ha. This variety is moderately tolerant to late blight.

Results and Discussion

Citation of the data regarding per cent plant emergence at 30 DAP revealed that there was no significant differences among all the treatments, but treatment T₁₁ - 150% RDF + 5.0 t/ha vermicompost (96.38%) had shown maximum per cent of plant emergence and lowest plant emergence (92.91%) at 30 DAP was observed in T₁ - absolute control.

The growth parameters of potato were significantly affected due to application of

organic and inorganic source of nutrients. The maximum plant height and dry matter accumulation was recorded significantly higher under treatment T₁₁ - 150% RDF + 5.0 t/ha vermicompost which was statistically at par with treatments, T₇ - 100% RDF + 5.0 t/ha vermicompost, T₈ - 100% RDF + 2.5 t/ha mustard oil cake, T₉ - 125% RDF + 5.0 t/ha vermicompost, T₁₀ - 125% RDF + 2.5 t/ha mustard oil cake and T₁₂ - 150% RDF + 2.5 t/ha mustard oil cake whereas the minimum plant height and dry matter accumulation were observed under treatment T₁ (absolute control) at all the growth stages.. It might be due to

more uptake of nitrogen during growth periods, resulted in increased cell size, elongation and enhancement of cell division which ultimately increase the plant height.

The increase in growth parameters might be because of batter photosynthetic area. Since nitrogen is one of the basic minerals associated with synthesis of protoplasm and in primary synthesis of amino acid. The result may be supported by the findings of Singh and Singh (1994), Raghav *et al.*, (2008), Barman *et al.*, (2014 and 2018) (Table 1–3).

Table.1 Plant emergence, plant height (cm) and dry matter accumulation (g/plant) at different growth stages as affected by different treatments

Treatment	% plant emergence at 30 DAP	Plant height				Dry matter accumulation (g/plant)			
		45 DAP	60 DAP	75 DAP	At harvest	45 DAP	60 DAP	75 DAP	At harvest
T ₁	92.91	20.42	24.31	31.21	31.24	16.12	21.83	32.28	44.12
T ₂	95.37	28.34	32.12	41.92	42.99	22.54	29.57	51.79	62.44
T ₃	94.57	25.12	29.17	36.27	36.38	20.21	25.44	45.32	56.41
T ₄	93.89	23.80	28.21	35.41	35.47	19.81	23.67	43.61	54.01
T ₅	94.11	27.45	31.30	40.74	40.81	21.35	28.73	50.21	60.51
T ₆	93.28	26.31	30.70	39.61	39.65	20.78	27.36	48.44	58.24
T ₇	96.03	30.31	34.71	44.11	44.24	27.33	34.73	57.03	68.41
T ₈	95.87	29.81	33.54	42.41	42.48	26.96	33.63	55.12	65.93
T ₉	96.34	31.47	35.86	46.26	46.34	28.41	35.56	59.29	70.13
T ₁₀	95.32	31.00	34.74	44.47	44.52	27.24	34.33	57.31	67.70
T ₁₁	96.38	32.32	37.12	47.52	47.57	29.23	36.90	60.97	71.96
T ₁₂	94.93	31.96	36.01	45.64	45.70	27.69	35.19	58.36	69.30
S Em (±)	3.37	0.854	1.027	1.459	1.482	0.891	1.104	1.83	2.22
CD (p=0.05)	9.88	2.506	3.014	4.280	4.345	2.614	3.238	5.36	6.50

Table.2 Number of shoots and leaves per plant at different growth stages as Affected by different treatments

Treatment	Number of Shoots				Number of leaves			
	45 DAP	60 DAP	75 DAP	At harvest	45 DAP	60 DAP	75 DAP	At harvest
T ₁	2.32	3.12	3.22	3.22	30.15	35.21	38.37	23.26
T ₂	4.03	4.98	5.11	5.11	39.23	45.31	49.39	32.18
T ₃	2.89	3.53	3.65	3.65	34.00	39.45	43.68	27.36
T ₄	2.71	3.40	3.54	3.54	33.43	39.31	43.21	27.11
T ₅	3.87	4.71	4.82	4.82	38.06	45.74	49.50	32.76
T ₆	3.65	4.56	4.68	4.68	36.44	42.51	46.62	30.20
T ₇	4.61	5.68	5.79	5.79	44.19	50.97	55.01	37.32
T ₈	4.52	5.48	5.59	5.59	42.58	48.22	51.31	34.10
T ₉	4.81	5.73	5.84	5.84	46.35	52.46	55.89	37.78
T ₁₀	4.75	5.61	5.80	5.80	44.89	51.37	54.96	36.91
T ₁₁	4.94	5.80	5.92	5.92	47.15	53.67	57.77	38.77
T ₁₂	4.88	5.77	5.90	5.90	46.99	53.11	56.83	38.29
S Em (±)	0.18	0.20	0.21	0.21	1.51	1.64	1.82	1.14
CD (p=0.05)	0.52	0.60	0.60	0.60	4.42	4.82	5.35	3.33

Table.3 Effect of different treatments on fresh tuber and vine yield and harvest index of potato

Treatments	Tuber yield (q/ha)	Yield of Vine (q/ha)	Harvest index (%)
T ₁	111.28	72.20	60.65
T ₂	233.30	106.69	68.62
T ₃	210.24	100.68	67.62
T ₄	207.02	99.45	67.55
T ₅	237.23	106.48	69.02
T ₆	235.58	105.59	69.05
T ₇	262.00	115.96	69.32
T ₈	259.67	116.72	68.99
T ₉	272.45	117.26	69.91
T ₁₀	269.23	117.15	69.68
T ₁₁	276.15	118.45	69.97
T ₁₂	273.87	118.21	69.85
S Em (±)	8.24	3.48	1.70
CD (p=0.05)	24.16	10.19	4.97

Number of shoots and no of leaves per plant significantly influences by the application of integrated nutrient management. Application of treatment T₁₁ (150% RDF + 5.0 t/ha vermicompost) recorded higher number of

shoots and leaves which was significantly superior over rest of the treatment but was statistically at par with treatments T₇ T₈ T₉ T₁₀ T₁₁ and T₁₂ whereas the minimum number of shoots and leaves was recorded under

treatment T₁ (absolute control) at all the successive growth stages. The application of organic manure improving soil structure, enhance water holding capacity of soil and microbial activity in the soil. This might be due to nutrients were recycled into the soil lead to increase the number of shoots and leaves which may have resulted in increased synthesis of carbohydrates utilized in building up of new cells.

Nitrogen increased the chlorophyll synthesis resulting in more area of photosynthesis and net assimilation. The leaves per plant decreased after the 90 days of planting, irrespective of the treatment due to senescence of leaves. This result is in accordance with the finding of Debasish *et al.*, (2001), Banjare (2012) and Etemad, B. and Sarajuoghi, M. (2012).

Tuber and vine yield

The highest tuber (276.15 q/ha) and vine yield (118.45 q/ha) was recorded with 150% recommended dose of fertilizer along with vermicompost which was significantly higher than other treatments but was at par with treatments T₇ T₈ T₉ T₁₀ T₁₁ and T₁₂. The maximum harvesting index (69.97) was also recorded under treatment T₁₁ (150% RDF + 5.0 t/ha vermicompost) whereas the minimum harvesting index (60.65) was observed under treatment T₁ (absolute control). Higher yield obtained with application of higher dose of fertilizers (NPK) might be due to positive response of potato crop to the nutrients like nitrogen, phosphorus and potash. The beneficial response of organic manure to increase the crop yield might also be attributed to the availability of sufficient amounts of plant nutrients throughout the growth period and especially at critical growth periods of crops resulting it's better uptake, plant Vigour and superior yield attributes. These results are in conformity

with the finding of Sarkar *et al.*, (2011), Banjare (2012), Patel (2013) and Kumar *et al.*, (2017).

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